3/ Appeal

PATENT
Docket No. PD-96315

Brief (B)

CUSTOMER NO.: 020991

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

KAR W. YUNG ET AL.
Serial No. 08/949,988
Filed: October 14, 1997
For: METHOD AND SYSTEM FOR MAXIMIZING SATELLITE CONSTELLATION COVERAGE

Date: December 3, 2001

Group Art Unit: 3644

Examiner: Dinh, T.

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APPEAL BRIEF
TRANSMITTAL LETTER

Box AF
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Enclosed is the Appeal Brief, **in triplicate**, for the above-identified patent application.

_____ Applicant petitions for an extension of time for _____ months(s). If an additional extension of time is required, please consider this a petition therefor.

Fee $_____________

_____ An extension for ______ months(s) has already been secured; the fee paid therefor of is deducted from the total fee due for the total months of extension now requested. $_____________

Extension fee due with this request $_____________

X Applicant believes that no extension of time is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition for extension of time.

_____ The Appeal Brief Fee was paid in a prior appeal in which there was no decision on the merits by the Board of Appeals.

X The Appeal Brief Fee of $**320.00** is due.

X The total fee due is **$320**. Please charge this amount to Deposit Account No. 50-0383 of Hughes Electronics Corporation, El Segundo, California. If any additional appeal brief fee or extension fee is required, please charge it to Deposit Account No. 50-0383.

This letter is submitted in triplicate.

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Respectfully submitted,

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V. D. Duraiswamy (Signature) December 3, 2001 (Date of Signature)

PATENT
Docket No. PD-96315

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Date: December 3, 2001

	Kar W. Yung, et al	
Serial No:	08/949,988	Group Art Unit: 3644
Filed:	October 14, 1997	Examiner: T. Dinh
Title:	METHOD AND SYSTEM FOR MAXIMIZING SATELLITE CONSTELLATION COVERAGE	

BRIEF ON APPEAL

Box AF
Honorable Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

The following Appeal Brief is submitted pursuant to the Notice of Appeal filed October 15, 2001 in the above-identified application.

1. Real Party in Interest

The real party in interest in this matter is Hughes Electronics Corporation, a corporation organized and existing under the laws of the State of Delaware, and having a place of business in El Segundo, California (hereinafter "Hughes"). Hughes is the assignee of the present invention and application. Also, Hughes is a wholly owned subsidiary of General Motors Corporation.

2. Related Appeals and Interferences

There are no other known appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

3. Status Of The Claims

Claims 1-21 are currently pending in this application (reproduced for reference in the attached Appendix) and stand under final rejection, from which this appeal is taken.

4. Status Of Amendments

The Notice of Appeal was submitted in response to the Final Office Action mailed September 5, 2001. No amendments have been filed subsequent to the final rejection.

5. Summary Of The Invention

Applicants' claimed invention solves the deficiencies present in prior systems. Specifically, independent claims 1, 10, and 20 provide a system (claim 10) and methods (claims 1 and 20) for maximizing satellite constellation coverage at predetermined peak local times for a set of predetermined geographic locations. According to the claims, a satellite constellation having a first coverage is determined. (See Spec., p. 5, lns. 3-16.) The satellite constellation includes at least two desired satellites 14. Each of the desired satellites 14 has a trajectory associated therewith. Each of the desired satellites 14 follows a specific trajectory defining the orbit 15 of each satellite as a function of time. (See Spec., p. 5, lns. 17-22 and Figure 2.) A period of orbit for each of the desired

satellites 14 is then determined. (See Spec., p. 5, ln. 23 through p. 7, ln. 12.) A time dependent coverage of the satellite constellation based on the orbit period and the trajectory of each of the desired satellites (14) is then determined. (See Spec., p. 7, lns. 13-31.)

Because the desired satellite constellation coverage depends upon the local time for the set of predetermined geographical locations, it is desirable to have the maximum possible number of satellites providing coverage at the set of predetermined geographic locations for about 7-12 hours a day during the middle of the day ("peak hours"). This is achieved by tilting the trajectory of at least one of the desired satellites 14 to reorient the satellite constellation to obtain a second coverage based on the time dependent coverage. The second coverage provides maximum coverage at the predetermined local times for the set of predetermined geographic locations. (See Spec., p. 8, lns. 1-23.) Command signals for modifying the trajectory of the at least one desired satellite based on the tilted trajectory are then generated and then sent to effectuate the necessary adjustments. (See Spec., p. 8, ln. 24 through p. 9, ln. 22.)

6. Issues

The following issue is presented in this appeal, and corresponds directly to the Examiner's final grounds for rejection in the Final Office Action dated September 5, 2001.

Whether U.S. Patent No. 4,809,935 issued to Draim ("Draim") in view of U.S. Patent No. 4,776,540 issued to Westerlund ("Westerlund") makes a *prima facie* showing of obviousness of claims 1-21.

7. Grouping of Claims

Claims 1-21 stand or fall together.

8. Argument

To establish *prima facie* obviousness of a claimed invention, each and every claim limitations must be taught or suggested by the prior art. *In re Rijckaert,* 9 F.3d 1531, 1532 (Fed. Cir. 1993). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Lowry,* 32 F.3d 1579, 1583 (Fed. Cir. 1994). If an independent claim is non-obvious under 35 U.S.C. §103, then any claim depending therefrom is non-obvious. *In re Fine,* 837 F.2d 1071 (Fed. Cir. 1988).

The extent of satellite constellation coverage that can be provided at predetermined geographical locations is limited by the configuration and coverage areas of the system being employed. As is understood, satellite constellations such as those used by mobile phone or terminal users have only a predetermined amount of resources. An example of such a system is disclosed in Draim, which teaches a satellite constellation for providing <u>continuous global coverage.</u> (Col. 2, lns. 14-20.) Specifically, Draim teaches the use of three satellites to provide "continuous hemispherical coverage." (Col. 2, ln. 22.) In other words, in the system of Draim, at least one satellite will be in

view at any time from any location in a hemisphere. Draim also teaches the inclusion of a fourth satellite to provide continuous global coverage (i.e., a satellite will be in view at any time from any location on the globe).

At peak times – the time when the resources of the system are most frequently needed or required – the system resources can often be fully utilized and are therefore not available to all users or subscribers. Because continuous coverage satellite systems, such as those disclosed in Draim, provide consistent resources to all areas at all times, they are therefore insufficient to solve the above described system resources problem.

The claimed invention, as recited in independent claims 1, 10, and 20, provides a method and system for maximizing satellite constellation coverage at predetermined local times for a set of predetermined geographic locations. The satellite constellation coverage includes a first coverage area and at least two desired satellites. Each of the desired satellites has a trajectory associated therewith. A period of orbit for each of the desired satellites is determined. A time dependent coverage of the satellite constellation is then determined based on the orbit period and the trajectory of each of the desired satellites.

As described on page 8, lines 11 of the specification, maximizing satellite constellation coverage depends on the local time (time of day) at a predetermined geographical location. It is desirable to have the maximum number of satellites providing coverage at the predetermined geographical location during the middle of the day to

provide maximum coverage during the high or peak usage times. This is achieved by tilting, or reorienting, the satellite constellation around the y axis in the equatorial plane. This process is accomplished by rotating the parameters defining the trajectory.

The claimed invention includes tilting the <u>trajectory</u> of at least one of the desired satellites to <u>reorient</u> the satellite constellation to obtain a second coverage <u>based</u> on the time dependent coverage. The second coverage provides maximum coverage at the predetermined local times for the set of predetermined geographical locations. Command signals for modifying the trajectory of the at least one of the desired satellites are then generated based on the tilted trajectory.

In the final Office Action, (and many of the previous Office Actions), the Examiner cited Draim as disclosing "a satellite constellation covering a specific geographical area at a predetermined local peak time, which time is well known, but is silent on the tilting [of] the trajectory to reorient the constellations to cover a second coverage." The Examiner thus cited Westerlund as teaching tilting satellites to "reorient" the satellite constellation to cover various geographical areas well known in the art. The Examiner then concluded that it would have been obvious to tilt the trajectory of the satellite constellation of Draim as taught by Westerlund to maximize the coverage area of the desired geographical area.

Draim expressly teaches a satellite constellation for continuous global coverage as well as hemispherical coverage. The Examiner contends that Draim does not show

continuous coverage to all areas and refers the Applicant to Figure 3 and columns 5 and 6 of the Draim reference. However, the Examiner is not correct. Draim teaches "continuous hemispheric coverage" through the use of three satellites, (Col. 2, lns. 14-20; Col. 4, ln. 12 – Col. 5, ln. 55) and further teaches that "the entire globe can be continuously covered with four satellites." (Col. 6, lns. 1-2.) Nevertheless, Draim does not teach or suggest maximizing coverage at predetermined geographical areas at local predetermined peak times – let alone maximizing coverage at any time. Moreover, Westerlund only teaches tilting the inclination angle of the satellites. The claimed invention is not tilting a physical object, but rather is <u>tilting the trajectory of the satellites to reorient the satellite constellation</u> as a function of the time dependent coverage of the satellite prior to tilting. Tilting the trajectory of the satellites may or may not affect the inclination angle of the satellites.

Moreover, the tilting of the satellite in Westerlund is for an entirely different purpose and is not for the purpose of maximizing coverage at a local geographical area during predetermined local times. Instead, Westerlund teaches orienting a spin axis of a satellite to compensate for any correction necessary due to deviation of the satellite from its desired target. In fact, the Westerlund specification teaches:

> Due to various phenomena, the orbital plane tilts (rotates) very slowly after a long period of time, for example, and assuring no north/south correction of the satellite's orbit will be shown at 115 (Fig. 5) in the plane 15 (Fig. 4).

(Col. 7, lns. 20-24.) The purpose for this reorientation is thus to prevent the use of thrusters and therefore to conserve fuel – not to reorient the trajectory of the satellite to maximize system coverage at a specific predetermined geographic location.

The method and system of the claimed invention provides a general systematic approach to synchronize coverage of an entire satellite constellation consisting of more than one satellite with local time. (See Spec., p. 1, lns. 22-25.) The tilting process of the method and system of the claimed invention shifts satellite resources towards "hot spots" at certain times. Then the motion of the earth relative to the orbit plane, not necessarily the motion of the earth relative to the individual satellites, brings the satellite resources to the daily traffic at proper times. Thus, the daily coverage provided by the entire satellite constellation matches the traffic needs at predetermined local times. In other words, the present invention is not concerned with continuous global coverage. In fact, when the trajectory of one or more satellites is tilted there may be instances where certain geographical locations do not have coverage.

There is simply no teaching or suggestion – let alone any motivation -- to combine Draim with Westerlund to arrive at Applicant's claimed invention. Moreover, none of the cited references teach or suggest the method and system of claims 1, 10, and 20. The references do not even recognize the same problem solved by Applicant and thus any combination of Draim and Westerlund constitutes impermissible hindsight

reconstruction. Claims 2-9, 11-19, and 21 depend from claims 1, 10, and 20 respectively and are submitted to be allowable for the same reasons provided above.

It is therefore respectfully submitted that all claims, are allowable over the cited art and that claims 1-21 overcome the section 103(a) rejection.

9. Appendix

A copy of each of the claims involved in this appeal, namely claims 1-21 is attached hereto as Appendix A.

10. Conclusion

For the reasons advanced above, Appellant respectfully contends that claims 1-21 are patentable over any combination of the cited prior art references. Therefore, reversal of the section 103(a) obviousness rejection is requested.

Respectfully submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPENDIX A

1. A method for maximizing satellite constellation coverage at predetermined local peak times for a set of predetermined geographic locations, the method comprising:

determining a satellite constellation having a first coverage, the constellation including at least two desired satellites, wherein each of the desired satellites has a trajectory associated therewith and a relative orbit within the satellite configuration;

determining a period of orbit for each of the desired satellites;

determining a time dependent coverage of the satellite constellation based on the orbit period and the trajectory of each of the desired satellites;

determining a second coverage based on the time dependent coverage, which provides maximum coverage by the satellite constellation at the predetermined local peak times for the set of predetermined geographic locations;

determining a tilted trajectory for each of the desired satellites to reorient the satellite constellation without changing the relative orbit of the at least two desired satellites with respect to each other within the satellite constellation so as to obtain the second coverage; and

generating command signals for modifying the trajectory of each desired satellite based on the tilted trajectory.

2. The method as recited in claim 1 wherein generating the command signals includes programming a computer with orbital parameters based on the tilted trajectory.

3. The method as recited in claim 2 further comprising launching each desired satellite with the orbital parameters programmed therein.

4. The method as recited in claim 1 wherein generating the command signals includes transmitting the command signals to each desired satellite.

5. The method as recited in claim 1 wherein determining the orbit period includes determining if the trajectory of each desired satellite is equatorial.

6. The method as recited in claim 5 wherein determining the orbit period includes determining the orbit period according to the following if the trajectory is equatorial:

$$P = [m_S D_S D_N / (n D_N + m_s D_s)],$$

where,

P is the orbit period with its sign indicating whether it is a direct or retrograde orbit:

n is an integer with its absolute value equal to the number of times that the satellite transverses the same geographic longitude within the repeating period;

m_s is the number of mean solar day per repeating period and must be a positive integer relatively prime to n;

D_s is the mean solar day, which is 24 hours or 1440 minutes; and

D_N is the nodal day which is the period of the earth-rotation relativo to the ascending node or any point of the orbit plane.

7. The method as recited in claim 5 wherein determining the orbit period includes determining the orbit period according to the following if the trajectory is not equatorial:

where,

$$P = \frac{T}{n + m_N}$$

m_N is the number of nodal day por repeating period which must be a positive integer relatively prime to n; and

T is the repeating period that the coverage pattern starts to repeat itself.

8. The method as recited in claim 1 wherein determining the time dependent coverage includes performing a simulation.

9. The method as recited in claim 1 wherein the trajectory is defined by a first coordinate system and wherein determining the tilted trajectory comprises:

translating the first coordinate system into rotation matrices;

transforming the rotation matrices based on the tilting; and

determining a second coordinate system based on the transformed rotation matrices.

10. A system for maximizing satellite constellation coverage at predetermined local peak times for a set of predetermined geographical locations, the satellite constellation having a first coverage and including at least two desired satellites wherein each of the desired satellites have a trajectory associated therewith and a relative orbit within the satellite constellation, the system comprising:

a processor operative to determine a period of orbit for each of the desired satellites to determine a time dependent coverage of the satellite constellation based on the orbit period and the trajectory of each of the desired satellites, to determine a second coverage based on the time dependent coverage which provides maximum coverage by the satellite constellation at the predetermined local peak times and the predetermined geographic locations, and to tilt the trajectory of each of the desired satellites within the satellite constellation to obtain the second coverage; and

means for generating command signals for modifying the trajectory of each of the desired satellite based on the tilted trajectory.

11. The system as recited in claim 10 wherein the means for generating is a computer programmed to launch each desired satellite into space with the modified trajectory.

12. The system as recited in claim 11 wherein the trajectory is a theoretical trajectory.

13. The system as recited in claim 10 wherein the means for generating is a satellite ground station operative to transmit and receive signals to and from each desired satellite.

14. The system as recited in claim 13 wherein the trajectory is an actual trajectory.

15. The system as recited in claim 10 wherein the processor, in determining the orbit period, is further provided for determining if the trajectory of each desired satellite is equatorial.

16. The system as recited in claim 15 wherein the processor, in determining the orbit period, is further operative to determine the orbit period according to the following if the trajectory is equatorial:

$$P = [m_s D_S D_N/(nD_N + m_s D_s)],$$

where,

P is the orbit period with its sign indicating whether it is a direct or retrograde orbit;

n is an integer with its absolute value equal to the number of times that the satellite transverses the same geographic longitude within the repeating period;

m_s is the number of mean solar day per repeating period and must be a positive integer relatively prime to n;

D_s is the mean solar day, which is 24 hours or 1440 minutes; and

D_N is the nodal day which is the period of the earth-rotation relative to the ascending node or any point of the orbit plane.

17. The system as recited in claim 15 wherein the processor, in determining the orbit period, is further operative to determine the orbit period according to the following if the trajectory is not equatorial:

where,

$$P = \frac{T}{n + m_N}$$

m_N is the number of nodal day per repeating period which must be a positive integer relatively prime to n; and

T is the repeating period that the coverage pattern starts to repeat itself.

18. The system as recited in claim 10 wherein the processor, in determining the time dependent coverage, is further operative to perform a simulation.

19. The system as recited in claim 10 wherein the trajectory is defined by a first coordinate system and wherein the processor, in tilting the trajectory, is further operative to translate the first coordinate system into rotation matrices, transform the

rotation matrices based on the tilting, and determine a second coordinate system based on the transformed rotation matrices.

20. A method for providing varying satellite constellation coverage at a plurality of geographic locations while maximizing the resources of the satellite constellation at all times, comprising:

providing a satellite constellation including a plurality of satellites each having a trajectory associated therewith and a relative orbit with said satellite constellation, said satellite constellation having a first coverage area;

selecting a first geographic location having a predetermined local peak time;

tilting each of said plurality of satellites to reorient said satellite constellation without changing the relative orbit of said plurality of satellites with respect to each other within said satellite constellation in order to obtain a second coverage area, which maximizes coverage at said first geographic location during said predetermined local peak time.

21. The method of claim 20, further comprising:

selecting a second geographic location having a second predetermined local peak time that is different from said first geographic location predetermined local peak time; and

tilting each of said plurality of satellites to reorient said satellite constellation without changing the relative orbit of said plurality of satellites with respect to each other within said satellite constellation in order to obtain a third coverage area, which maximizes coverage at said second geographic locating during said second predetermined local peak time.